

# EFFECT OF WEATHER ON SPRING BIRD MIGRATION IN NORTHERN ALABAMA

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IN VIEW of current interest in trans-Gulf migration, I herewith present the results of a four-year study (1947-1950) of the correlation of spring bird movement with weather at Birmingham, Alabama. In a large area of the Gulf States of Texas, Louisiana, Mississippi, Alabama, and Florida, true transient birds are notably scarce in spring (Lowery, 1946; Williams, 1950a and 1950b; and others). This study covers all night-migrating land birds that winter south of the Rio Grande and that breed east of the Mississippi but not within five miles of the place where I made observations. These 28 species are listed in Tables 1 and 2 and will be referred to in this paper as true transients.

True transients are generally recorded on the Gulf Coast only in weather associated with the passage of a cold front (Burleigh, 1944:9-10; Lowery, 1945:95-96; and others). However, at Birmingham, 220 miles inland, conditions are different. It is my hope that the differences as brought out by this study will increase our understanding of spring migration in the Gulf area.

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## METHODS

Within the periods March 1 to June 1 inclusive, in the four years of the study, I was afield on 130 days, averaging 32.5 days per spring period (93 days). Trips afield varied from one-half hour to 10 hours and averaged 2.15 hours. All daylight hours were included with most coverage between 6 and 9 a.m. Habitat coverage was approximately as follows: oak-pine woodland (65% hardwoods, 35% pine), 80%; lake shore, 8%; suburban residential areas developed from oak-pine woodland, 5%; farmland, including fallow fields mostly in broomsedge and aster, 3%; cattail marsh, 3%; and open short-grass airport, 1%. Numbers of species and individuals of true transients observed were recorded and correlated with weather data from the Birmingham station (U. S. Dept. Commerce, Weather Bureau, W.R.P.C., Chattanooga, Tenn., 1947-1950).

Detailed graphs were made showing a norm line based on more than 55 years of weather observations with adverse weather charted below this line and favorable weather above. Elements considered were wind direction and velocity, sky cover, precipitation, and departure from the normal temperature. These detailed graphs for March, April, and May, 1947 to 1950, are the bases for Tables 1, 2, and 3. Five weather factors were considered: *cold front*, *adverse* (north) *wind*, *south wind*, *rain alone* (*i.e.*, in absence of a front), and *clear, warm* weather. The frequency of occurrence of each factor is shown in Table 3, Column 1, covering the period when true transients were recorded (see footnote to Table 3).

A rather even sample of weather adverse due to one or another of the causes listed was obtained, as shown in Table 3, Column 2. Anyone afield at Birmingham notices that true transients are scarce in clear, warm weather. This is a characteristic of the Gulf Coast hiatus (Williams, 1950b:182)—hence I was seldom afield in such weather. However, I obtained sufficient data to show that the number of true transients seen per day under such conditions is considerably lower than during adverse conditions (see Table 3, Column 7).

In other words it should be understood that adverse weather, as here used, means weather adverse to migration of birds (*i.e.*, favorable for observation of grounded migrants), while favorable weather (*clear, warm* and to a lesser extent, *south wind*), being good for migration of true transients, is unfavorable for observation and results in few such birds being seen.

#### WEATHER PRINCIPLES

The U. S. Weather Bureau, on the reverse side of its daily weather map for Monday of each week, states:

The boundary between two different air masses is called a front. Important changes in weather and temperature often occur with the passage of a front . . . The boundary of relatively cold air of polar origin advancing into an area occupied by warmer air, often of tropical origin, is called a cold front. The boundary of relatively warm air advancing into an area occupied by colder air is called a warm front. A boundary between two air masses, which shows little tendency at the time of observation to advance into either the warm or the cold areas, is called a stationary front. Air mass boundaries are known as surface fronts when they intersect the ground, and as upper air fronts when they do not.

Winds in the northern hemisphere rotate clockwise around a high pressure area and counterclockwise around a low pressure area. The typical cold front has a low pressure area at its eastern or northern end. Hence winds in the warm sector are southwesterly, passing counterclockwise around the eastern end of the low and usually producing a warm front. On the western side of the low, this counterclockwise rotation produces a NW wind which pushes

TABLE I  
WEATHER AT BIRMINGHAM IN SPRING IN RELATION TO MIGRANTS BREEDING  
NORTH OF ALABAMA

Species*	Winter Range†	Main Flyway†	No. of migrants seen with each weather factor. (Column A, no. of records; Column B, no. of individuals.)														
			Cold Front		Adverse Wind		South Wind		Rain Alone		Clear Warm		Total				
			A	B	A	B	A	B	A	B	A	B	A	B			
Chestnut-s.																	
Warbler	CA	M,A	4	4	3	15	1	2	3	16	1	1	12	38			
Bobolink	SA	A	2	247	4	30	1	2	3	3			10	282			
Bay-br.																	
Warbler	SA	A	3	8	3	23	2	12	2	3			10	46			
Black-poll																	
Warbler	SA	A	2	17	2	5	2	11	3	33			9	66			
Blackburnian																	
Warbler	SA	A	2	2			2	5	4	5	1	1	9	13			
Olive-b.																	
Thrush	CA&SA	M,A	2	8			3	5	3	9			8	22			
Rose-br.																	
Grosbeak	CA&SA	M,A	2	3	1	1	2	10	2	3			7	17			
Veery	SA	M,A	1	2	1	1	2	7	2	6	1	1	7	17			
Tennessee																	
Warbler	CA&SA	M	2	3	1	4	1	1	2	9			6	17			
Magnolia																	
Warbler	WI&CA	M,A	2	5	2	6			2	3			6	14			
Gray-cheeked																	
Thrush	SA	M,A	1	3	1	2	1	1	1	2			4	8			
Golden-w.																	
Warbler	CA	M	1	1			3	5					4	6			
Cape May																	
Warbler	WI	A	1	1			1	1	2	3			4	5			
Black-billed																	
Cuckoo	SA	A					1	1	1	2			2	3			
Philadelphia																	
Vireo	CA	M,A	1	1									1	1			
Least																	
Flycatcher	CA	A			1	1							1	1			
16 species			26	305	19	88	22	63	30	97	3	3	100	556			

\* Spring records of others: Olive-sided Flycatcher (*Nuttallornis borealis*), SA; Nashville Warbler (*Vermivora ruficapilla*), CA; Black-throated Blue Warbler (*Dendroica caerulescens*), WI, A; Northern Water-thrush (*Seiurus novaboracensis*), WI, A; Connecticut Warbler (*Oporornis agilis*), SA; Mourning Warbler (*Oporornis philadelphia*), CA&SA, M; Wilson's Warbler (*Wilsonia pusilla*), CA; and Canada Warbler (*Wilsonia canadensis*), SA.

† Peterson, 1947

the cold air southeastward and invades the warm sector (U. S. Dept. Agriculture Yearbook, 1941). This explains the wind shift from SW to NW when the

TABLE 2

WEATHER AT BIRMINGHAM IN SPRING IN RELATION TO MIGRANTS BREEDING  
IN ALABAMA BUT NOT NEAR THE SITE OF OBSERVATION

Species*	Winter Range†	Main Flyway†	No. of migrants seen with each weather factor. (Column A, no. of records; Column B, no. of individuals.)												
			Cold Front		Adverse Wind		South Wind		Rain Alone		Clear Warm		Total		
			A	B	A	B	A	B	A	B	A	B	A	B	
Black and White															
Warbler	US	M,A	9	27	3	7	5	13	8	16	1	4	26	67	
Cerulean															
Warbler	SA	M	7	15	2	2	4	25	4	7			17	49	
Ovenbird	US	A	5	10	3	13	3	11	6	7			17	41	
Scarlet															
Tanager	SA	M,A	3	11	4	6	4	26	4	23	1	1	16	67	
Am. Redstart	WI, CA, SA	M,A	3	6	3	9	4	5	3	4	1	1	13	24	
Black-thr.															
Gr. Warbler	CA	M,A	3	6	3	3	3	3	2	3			11	15	
Eastern															
Kingbird	CA&SA	M,A	3	28	1	14	3	10			1	4	8	56	
Worm-eating															
Warbler	WI&CA	M,A	2	4			2	5	2	3			6	12	
Blue-winged															
Warbler	CA	M,A	1	1	1	1	1	1	1	1			4	4	
Parula															
Warbler	US	M,A	1	1	1	1	2	2					4	4	
Yellow-thr.															
Warbler	WI	A	1	2	1	3	1	1					3	6	
La.															
Water-Thrush	CA&WI	A	1	1	1	1							2	2	
12 species			39	112	23	60	32	102	30	64	3	9	127	347	

\* Spring records of others: Warbling Vireo (*Vireo gilvus*), CA, breeds rarely in nw Ala.; and Baltimore Oriole (*Icterus galbula*), CA&SA, breeds or bred rarely in n. Ala.  
† Peterson, 1947.

typical cold front approaches from the northwest (see Figs. 1 and 2). This invasion of cold air generally blocks migrating birds in spring.

CORRELATION OF MIGRATION WITH WEATHER

*Cold Front.*—Because nearly all lows and highs pass north of Birmingham, winds there shift clockwise (veer) completely around the compass, producing a typical weather cycle lasting usually from two to ten days. Starting with a SW wind, we find that this brings in the warm, moist, light air from the Gulf of Mexico, resulting in cloudy weather and rain. Then comes the *cold*

*front* behind which is a wedge of heavy, cold, dry air which forces the lighter Gulf air mass to rise and to precipitate its moisture. The wind shifts immediately to NW, skies eventually clear, and it becomes cold. The attendant low pressure area moves eastward or northeastward and, as the cold air mass behind the front invades the warm sector, migrating birds encounter cloudiness, rain, then clearing, with a head wind and lower temperatures.

Occluded and stationary fronts were considered cold fronts when the wind shifted to northwesterly, although, due to their nature, they were much milder in action.

Typical of 16 observations of migration following a *cold front* is that of May 2, 1949. On May 1, the wind averaged SSE, almost 13 m.p.h., the temperature averaged 5° F. above normal, and precipitation was 1.44 in. May 2 was rainy and heavily overcast, clearing about 4 p.m. with gusty winds. The weather bureau recorded an average wind of 8 m.p.h. from the NNW, temperature 1° F. below normal, precipitation, .08 in. The precipitation followed by a sudden shift to strong northwesterly winds and the drop in temperature are characteristic *cold front* phenomena.

On May 2, during 9 hours in the field, I saw 98 species, 18 of which are considered here as true transients. The latter were: Eastern Kingbird (*Tyrannus tyrannus*), 25; Olive-backed Thrush (*Hylocichla ustulata*), 7; Gray-cheeked Thrush (*H. minima*), 3; Veery (*H. fuscescens*), 2; Black and White Warbler (*Mniotilta varia*), 3; Golden-winged Warbler (*Vermivora chrysop-tera*), 1; Black-throated Green Warbler (*Dendroica virens*), 3; Cerulean Warbler (*D. cerulea*), 1; Blackburnian Warbler (*D. fusca*), 1; Chestnut-sided Warbler (*D. pensylvanica*), 1; Bay-breasted Warbler (*D. castanea*), 3; Black-pollled Warbler (*D. striata*), 16; Ovenbird (*Seiurus aurocapillus*), 2; Louisiana Water-thrush (*S. motacilla*), 1; American Redstart (*Setophaga ruticilla*), 2; Bobolink (*Dolichonyx oryzivorus*), 240; Scarlet Tanager (*Piranga olivacea*), 6; and Rose-breasted Grosbeak (*Pheucticus ludovicianus*), 1.

Other migrants observed the same day included the Common Loon (*Gavia immer*), Black-crowned Night Heron (*Nycticorax nycticorax*), three species of ducks, Osprey (*Pandion haliaetus*), Barn Swallow (*Hirundo rustica*), three species of transient wrens, and large flocks of many resident species, including Blue Grosbeak (*Guiraca caerulea*), 22. Since these species are resident part of the year at Birmingham, they cannot be considered as true transients for the purpose of this paper although many individuals may be.

*Adverse Wind.*—The northerly winds, or *adverse winds*, which follow a cold front usually last two or three days and the weather is clear and cool. This weather is characteristic of the eastern side of a high (see Fig. 2). Birds are generally grounded by strong head winds, but when the winds lessen they

probably move on. Lowery (1945:97-98) and Weston (1947:152) say that migrants usually leave the Gulf coast the day after passage of a cold front. Possibly many true transients seen at Birmingham during periods of adverse winds were grounded in Gulf coast areas by a cold front.

On May 10, 1947, I observed a concentration of true transients held up by unfavorable winds, typical of 11 such instances noted. On May 9, the wind had averaged NE, 12.5 m.p.h., temperature was 9° F. below normal. Ten Bobolinks were the only true transients seen. On May 10, the wind was still NE but with negligible velocity and the temperature was 10° F. below normal. However, 11 species of true transients were seen, as follows: Black and White Warbler, 3; Tennessee Warbler (*Vermivora peregrina*), 4; Magnolia Warbler (*Dendroica magnolia*), 2; Black-throated Green Warbler, 1; Chestnut-sided Warbler, 4; Bay-breasted Warbler, 8; Black-poll Warbler, 4; Ovenbird, 4; American Redstart, 3; Bobolink, 14; and Scarlet Tanager, 3.

*South Wind.*—While northerly winds prevail, there is a gradual shift from NW to NE or NNE under the influence of a high pressure cell moving eastward. When this cell—at the station or north of it—passes east of the observer, the wind shifts from NE to SE or SSE. This is the *south wind* typical of the western side of a high (see Fig. 3). In spring, noticeable warm fronts are seldom recorded at Birmingham because the cold, dry air masses are greatly modified by the proximity of the Gulf of Mexico.

True transients are observed at Birmingham on the day of a wind shift to southerly as described above. This is the resumption of migration which Bagg *et al.* (1950:13) say occurs when a region becomes part of the warm sector of a low pressure area or the western side of a high. During the balance of the period of southerly winds, the arrival of most of the local summer residents is recorded and daytime migrants such as hawks and swallows are observed. Although few true transients are seen by day on the ground (see *clear, warm*), observations of birds passing before the moon show that heavy migration is taking place.

Of 16 such days in four years with a shift to *south wind*, April 19, 1947, is typical. On the two preceding days, winds were northerly and the average temperatures 10° F. and 8° F. below normal, respectively. On April 19, the wind shifted to south, the temperature was normal and there was no precipitation. The following true transients were seen: Olive-backed Thrush, 2; Black and White Warbler, 1; Worm-eating Warbler (*Helmitheros vermivorus*), 1; Golden-winged Warbler, 2; Cerulean Warbler, 10; Blackburnian Warbler, 2; Ovenbird, 1; and American Redstart, 2.

*Rain Alone.*—Frequently, true transients were seen during rain not associated with the passage of a cold front or other adverse weather. Apparently

the *rain alone* was sufficient to ground these birds. Typical of 17 such observations was that of April 21, 1949.

On April 20, the wind was ESE, 9 m.p.h., and, although April 20 was the second day of southerly winds, the temperature was 7° F. below normal. On April 21, the wind was still ESE and averaging 12 m.p.h., the temperature was 3° F. below normal, and .2 inches of rain fell. I saw the following true transients during this rain: Worm-eating Warbler, 2; Cape May Warbler (*Dendroica tigrina*), 1 (unusual this far west but the wind had been easterly for three days); Black-poll Warbler, 16; Ovenbird, 1; and Scarlet Tanager, 8.

*Clear, Warm.*—This is the most favorable weather for spring migration, with moderate tail winds (southerly), good visibility, and generally good flying conditions. Usually, *clear, warm* weather occurs in April the day after a high passes to the east. Examples are April 23, 1947 (Veery, 1; Eastern Kingbird, 4); April 7, 1948 (Black and White Warbler, 4); and April 26, 1949 (Scarlet Tanager, 1). Early in spring, however, rainy weather preceding the next cold front usually arrives the day after a southerly wind resumes.

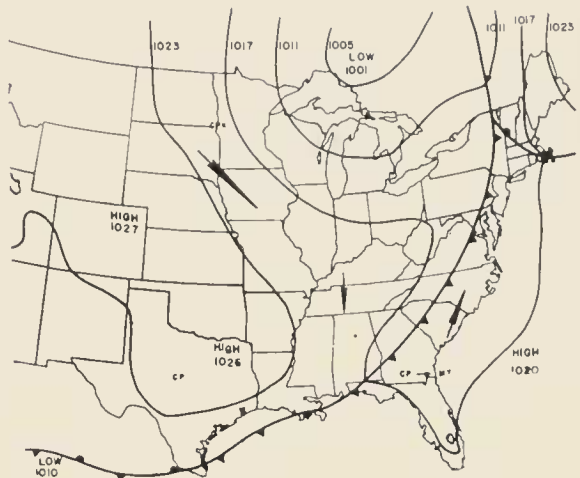
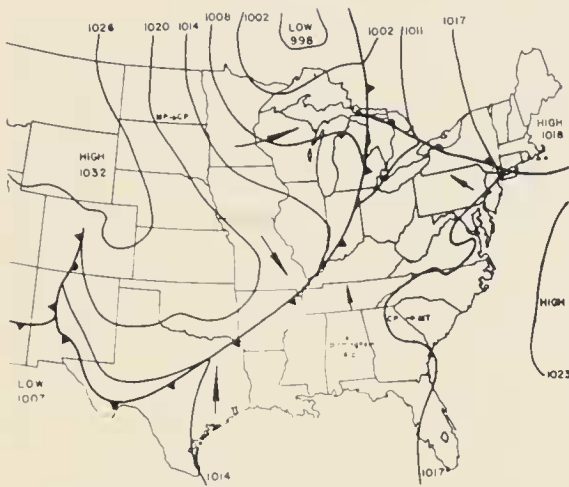
In May, this *clear, warm* weather usually persists a week or longer. Records of true transients are: May 16, 1947, the 6th day of a 10-day period of southerly winds, Blackburnian Warbler, 1; May 10, 1950, the 9th day of a similar 13-day period, Chestnut-sided Warbler, 1.

#### A TYPICAL WEATHER CYCLE

In order to show more fully the relationships of these weather components to migration, a complete weather cycle, from April 16 to 22, 1950 is analyzed below. (Figs. 1, 2, and 3 are weather maps for parts of this cycle.) During the 372 days of the study in four years, 65 such cycles were recorded.

On April 16, 1950, Birmingham experienced its fifth straight day of *cold, clear* weather after passage of a cold front on April 11, with the cold air coming from the eastern side of a high pressure area in mid-continent. Late on April 17 this high passed to the east of Birmingham, the wind veered to S, the temperature was only 2° F. below normal, and .03 in. of rain fell.

On the 18th, 74 species of birds were observed in 5.5 hours spent almost entirely in woodland and around a small lake. The wind was SSE, temperature normal, and .68 in. of rain fell. One Parula Warbler (*Parula americana*) and one Ovenbird were the only true transients seen. Also seen were five species of ducks (including 163 Lesser Scaup, *Aythya affinis*), Osprey, Sora (*Porzana carolina*), Wilson's Snipe (*Capella gallinago*), Spotted Sandpiper (*Actitis macularia*), Solitary Sandpiper (*Tringa solitaria*), Winter Wren (*Troglodytes troglodytes*), Long-billed Marsh Wren (*Telmatodytes palustris*), and Blue-headed Vireo (*Vireo solitarius*). As usual, a good portion of the migrants seen are species that winter locally or on the Gulf Coast, and rarely breed in Alabama.



FIGS. 1 and 2 (upper left and right). Weather maps for 1:30 a.m., April 19, 1950, and 1:30 a.m., April 20, 1950. Cold front approaches Birmingham from the northwest. Air mass behind it is a mixture of Maritime Polar (MP on maps) and Continental Polar (CP on maps) air as indicated over the Dakotas. The southeastern states are covered by a Continental Polar air mass which has been mixed with Maritime Tropical (MT on maps) air from the Gulf. Arrows indicate wind flow and a condition favorable for migration from the Texas coast to the warm front over New York. This cold front passed Birmingham at 1:30 p.m. April 19 and 12 hours later had reached a position as shown in

Fig. 2, bringing unfavorable conditions for migration to all the eastern states except a narrow strip along the Atlantic coast. See text for details of weather and birds observed at Birmingham on April 18 and 19.

FIG. 3 (lower left). Weather map for 1:30 a.m., April 22, 1950. Conditions favorable for resumption of migration. The high centered over Wyoming on April 19 (see Fig. 1), while moving south to Texas, has poured cold air into the southeastern states and blocked spring migration with its northerly winds. At 1:30 p.m. on April 21 this high was over Alabama and Fig. 3 shows it in Georgia. Now east of Birmingham, its clockwise rotation brings southerly winds on its western side and migration is resumed there. Both warm fronts (over Texas and Missouri) are disintegrating as is also the Minnesota cold front with hollow 'teeth.' See text for weather details and birds observed at Birmingham on April 22.

Another cold front arrived on the 19th; the temperature was 2° F. above normal but went to 9° F. below normal the next day and the wind veered to NW after a trace of rain. In 2¾ hours afield on the 19th, I saw seven species of true transients: Philadelphia Vireo (*Vireo philadelphicus*), Black and White Warbler, 3; Worm-eating Warbler, 3; Tennessee Warbler, 1; Cerulean Warbler, 6; and Ovenbird, 5. Other migrants included in a total of 66 species observed were uncommon winter residents: Palm Warbler (*Dendroica palm-*



TABLE 3  
RELATIVE INFLUENCE OF WEATHER FACTORS ON MIGRANTS IN SPRING  
AT BIRMINGHAM, ALABAMA\*

Column number	1	2	3	4	5	6	7
Weather factors	No. of Occurrences	No. of days afield during phenomena	No. of days on which migrants were seen	% of days afield (Column 2)	No. of migrants seen	% of all migrants seen	Migrants per day (Column 5/Column 3)
Cold Front .....	48	25	16	64.0	417	46.2	26.2
Adverse Wind .....	67	26	11	42.3	148	16.5	13.5
South Wind .....	47	22	16	72.7	165	18.3	10.3
Rain Alone .....							
(not on frontal days)	72	25	17	68.0	161	17.8	9.5
Clear Warm .....	43	10	5	50.0	12	1.2	2.4
Total .....	277	108	65	60.0	903	100.0	(mean) 14.0

\* The first migrants for the year were seen in 1947 on Mar. 29; 1948, Mar. 30; 1949, Mar. 19; and 1950, Mar. 28. Above figures are from those early dates until June 1. Peaks of migration for true transients; 1947, Apr. 14–May 10; 1948, Apr. 25–May 14; 1949, Apr. 11–May 12; 1950, Apr. 8–May 1.

arum), House Wren (*Troglodytes aëdon*), Pine Siskin (*Spinus pinus*), and White-crowned Sparrow (*Zonotrichia leucophrys*); early-arriving summer residents: Yellow-breasted Chat (*Icteria virens*), Blue Grosbeak, Indigo Bunting (*Passerina cyanea*), and Dickcissel (*Spiza americana*); and one transient: Upland Sandpiper (*Bartramia longicauda*).

April 20 and 21 were days of *adverse winds*; the *south wind* resumed on April 22 with a shift from NE to SW, a trace of rain, and a sharp rise in temperature. On the 22nd I saw four species of true transients: Golden-winged Warbler, 1; Parula Warbler, 1; Cerulean Warbler, 5; and Ovenbird, 3. Migrant Chuck-will's-widows (*Caprimulgus carolinensis*) and Blue-headed Vireos were also seen.

#### DISCUSSION AND CONCLUSIONS

*Correlation of Migration with Weather.*—Almost half the individuals (46.2%) of all true transients were recorded on days when the wind shifted to strong northwesterly, that is, days when a *cold front* grounded migrating birds. An average of 26.2 (individual) true transients were seen on each such day afield (12 per hour). The effect of other weather factors is as shown in Table 3, column 7. Although I spent only 10 of 108 *clear, warm* days afield and saw only 1.2 per cent of all true transient individuals in such weather, the average of 2.4 birds per trip in *clear, warm* weather as compared to 14 true transient individuals per trip for all types of weather seems significant.

*Urgency of Spring Migration.*—In spring, apparently, the individual migrating bird takes advantage of favorable weather to advance as far as possible. Frequently, especially after a period of strong southerly winds,

some birds, notably warblers, are found far north of their usual range. For instance, in the New York City region up to 1941 there were 42 spring records for the Prothonotary Warbler (*Protonotaria citrea*) and 15 spring records for the Yellow-throated Warbler (*Dendroica dominica*) (Cruikshank, 1942:372, 394). Neither of these birds normally breeds at New York. In late March, 1950, no less than 14 Hooded Warblers (*Wilsonia citrina*) reached Wisconsin, Illinois, Ohio, and Ontario during a period of strong southerly winds (Robbins, 1950:232). In a similar period in April, 1947, the Blue-gray Gnatcatcher (*Polioptila caerulea*), White-eyed Vireo (*Vireo griseus*), Worm-eating Warbler, Hooded Warbler, Summer Tanager (*Piranga rubra*), and Harris's Sparrow (*Zonotrichia querula*) reached Toronto, Ontario (Gunn and Crocker, 1951:142). In my study, also, migrants seemed to move northward whenever weather permitted.

*Migration by Day.*—Urgency of migration is such that on occasion some true transients migrate by day. Lowery (1945:95) and Williams (1945:108) state that the arrival of a cold front in daylight will precipitate these migrants. A typical example at Birmingham is that of April 25, 1947. At 1 p.m. the wind was SW, the temperature 78° F., and rain was commencing. At 2 p.m. it was 79° F., and at 3 p.m. with a wind shift to NW, the temperature had dropped to 65° F. At 4 p.m. the rain stopped and the weather began to clear. At 4:30 p.m. I saw the following on a wet field: Little Blue Heron (*Florida caerulea*), 2; Solitary Sandpiper, 2; Lesser Yellow-legs (*Totanus flavipes*), 1; and Bobolink, 1.

*Winter Range.*—During the four-year study, I recorded 28 species of true transients. Some records of all but the Black-billed Cuckoo (*Coccyzus erythrophthalmus*), Least Flycatcher (*Empidonax minimus*), and Blue-winged Warbler (*Vermivora pinus*) are mentioned above. Of these 28 species, 9 winter in South America, 5 in South and Central America (American Redstart also in the West Indies), and 14 in Central America and the West Indies (3 of the last, the Black and White Warbler, Parula Warbler and Ovenbird, also winter in southern United States, especially in Florida). Of the individuals recorded, 61% winter in South America, and 23.9% in Central America and the West Indies. However, by number of records there were 37% of South American-wintering species, and 44.5% of those that winter in Central America and the West Indies. In short, I saw more South American-wintering individuals, but saw Central American and West Indian winterers more frequently. The difference, percentage-wise as in Table 4, indicates a relatively even mixture of the two categories.

*Equality of Adverse Weather Types.*—The distribution of records of true transients observed during the various types of adverse weather is remarkably uniform. Of the 28 species, 26 were seen immediately after *cold fronts*,

TABLE 4

FREQUENCY OF SPRING MIGRANTS AT BIRMINGHAM, ALABAMA, IN RELATION  
TO THEIR ORIGINS AND DESTINATIONS\*

Origin	Destination						Totals by origin			
	North of Alabama			Alabama			Rec.	Per-	Indivi-	Per-
	Rec-ords	Indivi- duals	Per- cent	Rec-ords	Indivi- duals	Per- cent	ords	cent	duals	cent
S. America (9 species, of 28) ....	51	435	79.0	33	116	21.0	84	37.0	551	61.0
Cent. Amer., W. Indies, southern U. S. (14 species, of 28) ....	28	65	30.0	73	151	70.0	101	44.5	216	23.9
S. Amer., Cent. Amer., W. Indies, southern U. S. (5 species, of 28) ....	21	56	41.2	21	80	58.8	42	18.5	136	15.1
Totals (by destination) .....	100	556		127	347		227	100.0	903	100.0

\* Long range migrants, wintering in South America and breeding north of Alabama, comprise 48.2% (435/903) of all true transients seen. Short range migrants, wintering in Central America, West Indies, and southern U. S. and breeding—at least in part—in Alabama, comprise 16.7% (151/903). Medium range migrants comprise the remaining 35.1%.

21 during periods of *adverse winds*, 24 immediately after resumption of *south winds*, 21 on days of *rain alone* (that is, rain not associated with frontal wind shifts), and only 6 in (favorable) *clear, warm* weather (shown in detail in Tables 1 and 2).

*Flyways.*—The coastal hiatus is described by Williams (1950b:176–179) as a triangle with a base along the Gulf Coast from about Houston to about Tallahassee, and the apex near where Alabama, Mississippi, and Tennessee meet. Of 227 records of true transients (one record being one day's observation of a species), 133 (58.6%) are of species using both the Mississippi and Atlantic Flyways; 67 (29.5%) are Atlantic Flyway birds, and only 27 (11.9%) are Mississippi Flyway users. These data (shown by species in Tables 1 and 2) suggest that Birmingham lies near the apex of this triangle and closer to its eastern (Atlantic Flyway) side. This agrees with Williams' map (1950b:178) except that perhaps the eastern leg should be at least 50 miles further east.

## SUMMARY

A study was made for 1947–1950 at Birmingham, Alabama of 227 spring records of 28 species of land birds that winter south of the Rio Grande and breed east of the Mississippi River. Daily weather at Birmingham was labelled *cold front*, *adverse* (north) *wind*, *south wind*, *rain alone*, and *clear*,

warm, and the numbers and kinds of transient birds recorded on each day afield were tabulated and studied. These true transients (*i.e.*, night migrating land birds wintering south of the Rio Grande and breeding east of the Mississippi, but not locally) were found in all types of weather but especially after a *cold front* (46.2%) and seldom in *clear, warm* weather (1.2%).

Most of the individuals seen (58.6%) were of species that use both the Atlantic and Mississippi Flyways. Birds that winter in Central America and the West Indies were seen more often (44.5% of the records), but South American winterers were more numerous (61.0% of the individuals).

Birmingham probably lies within the triangular hiatus of Williams (1950b: 178) on the eastern side near the apex.

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